Modeling the Hardy Weinberg Law

Introduction:

In this lab you will further your understanding of how natural processes cause changes in the allele frequencies in a population – Evolution.

Background: Facts about the "Moth" Population

1. Moths come with two phenotypes: White and Speckled:
    a. Speckled: this is the **recessive allele** (q)
    b. White: this is the **dominant allele** (p)

2. New moths are born every 'year'; the birth rate equals the death rate. You simulate births by reaching into the container of 'spare moths" and selecting randomly.

3. Since the speckled trait is recessive, the speckled moths are homozygous recessive (q^2). Because the white trait is dominant, the white moths are **EITHER** homozygous dominant or heterozygous (p^2 or 2pq).

4. Your group will perform 4 trials with 5 generations each.

General Procedures:

- Start out your sample population with 10 moths of each color (Generation 0)
- Randomly pick 5 moths to "die" (remove 5 moths from your current population without looking).
- Randomly pick 5 moths from the container to re-establish the population of 20.
- Record the observed number of recessive phenotype moths into table 1.
- Repeat for the remaining generations.

Empty all the moths back into the container when finished each trial

All trials will be tested by a Chi Square and the **expected values will always be 10** for the recessive phenotype since that means an equal amount of dominant & recessive across generations (No evolution). Each trial will serve as an exercise to see if the populations stay in equilibrium (10/10) or if some factor is causing allele frequencies to change)

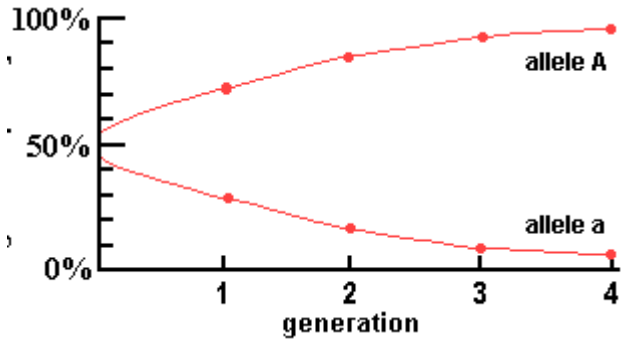
Trial 1 – Allele Frequency Changes with no Factors Changed on Purpose

Data Table 1 – Chi Square test for no change in recessive allele frequencies over 4 generations.

	Expected number	Observed number
Generation 1		
Generation 2		
Generation 3		
Generation 4		

a. Plot the dominant & recessive allele **frequencies** over time (in generations) on graph paper. You must **calculate** these values based on the observed number of moths out of the sample population of moths (20). Use the figure below as a model for setting up your graphs.

Each graph should be labeled "Figure __number__" with a descriptive title aligned to the trial.



b. Perform the Chi square test, make a decision about the null hypothesis, and provide a justification for why any changes might have occurred in the population's allele frequency. (Reflect on the 5 conditions for H-W equilibrium and which factor(s) may not have been met or state that they were all met if that is the case).

Trial 2 – Allele Frequency Changes for Variable 1

In the 1970's, the increase of industry in England caused a lot of pollution to turn the trees a whitish color instead of their usual dark brown. The color change in the trees did not itself confer any harm to the moths, so the moths would rest on the sides of the trees when not flying as they usually did before the color change.

Propose a likely trend in moth phenotype frequencies based on this information.

Design and **justify** a method to simulate this in your procedures.

Perform the steps of trial 1 with your modified procedures included.

Data Table 2 – Chi Square test for no change in recessive allele frequencies over 4 generations.

	Expected number	Observed number
Generation 1		
Generation 2		
Generation 3		
Generation 4		

Perform all analyses as in trial 1 a & b.

Trial 3 – Allele Frequency Changes for Variable 2

A moth population in Cuba with the same phenotypes as in England underwent a change in its population that was not fully understood. The female moths began exhibiting a preference for mating with the speckled males instead of the white males. There was no apparent survival advantage to either phenotype based on color pattern which made this phenomenon so puzzling.

Propose a likely trend in moth phenotype frequencies based on this information.

Design and **justify** a method to simulate this in your procedures.

Perform the steps of trial 1 with your modified procedures included.

Data Table 2 – Chi Square test for no change in recessive allele frequencies over 4 generations.

	Expected number	Observed number
Generation 1		
Generation 2		
Generation 3		
Generation 4		

Perform all analyses as in trial 1 a & b.

Trial 4 – Allele Frequency Changes for Variable 3

For 1 of the hardy Weinberg conditions not already simulated, design a scenario in paragraph format about a fictitious event that occurred involving that condition.

Propose a likely trend in moth phenotype frequencies based on your scenario.

Design and **justify** a method to simulate this in your procedures.

Perform the steps of trial 1 with your modified procedures included.

Data Table 2 – Chi Square test for no change in recessive allele frequencies over 4 generations.

	Expected number	Observed number
Generation 1		
Generation 2		
Generation 3		
Generation 4		

Perform all analyses as in trial 1 a & b.

Construct all of the information in this lab into a formal "Practice" lab report that includes all the components on the report rubric.